# Characteristics of common experimental animals

1. Characteristics of the digestive tract

A. Teeth

Rodents are the most diverse group of mammals. The most obvious common feature between rodents and lagomorphs is that both the upper and lower jaws have open-rooted incisors and both have no canines. Therefore, malocclusion of the incisors has become a common disease for them. In terms of the number of incisors, rodents have one pair on the upper and lower jaws; lagomorphs have one pair of very small incisors on the upper jaw. These incisors, which are constantly growing, must grind their teeth by biting hard objects, so they are also the tools they use to "make holes".

B. Stomach

Among the animals mentioned in this section, rabbits and guinea pigs are herbivores, while the other three are Old World omnivores. The lining of the forestomach of Old World rodents is horny to facilitate the digestion of hard food. However, the stomach of rabbits will still contain gastric contents no matter how long they have been fasted, so there is no need to fast before anesthesia for surgical experiments.

C. Large cecum and coprophagic behavior

The cecum of rodents and lagomorphs is very large and plays an important role in the digestive physiology of these animals. They all have coprophagy behavior, that is, the nutrients metabolized by the cecal microflora (microflora) are excreted through the feces at specific times every day, and then taken in through the mouth. The administration of antibiotics to avoid wound inflammation after surgical procedures often leads to the death of a large number of normal microflora in the intestines, resulting in intestinal bulges. Therefore, the use of antibiotics in these animals must be avoided.

2. Nocturnal animals

Like most mammal species, rodents are nocturnal animals, resting during the day and active at night. Therefore, in the artificial light-controlled breeding room of the animal center, "active mice" are rarely seen "during the day", but after "lights out", Outside the breeding room, you can hear noises coming from inside the room from time to time until dawn. Most lagomorphs in the wild are nocturnal, but domesticated rabbits seem to have no obvious distinctive activity between day and night. When the

animal center of our school designs the light control of the breeding room, in order to prevent them from being stressed due to excessive light when they are "resting during the day", the timer only controls 1/3 to 1/2 of the fluorescent lights in the breeding room. Here again, colleagues and students are reminded that if you turn on extra lights due to insufficient lighting when in the breeding room, remember to turn them off when leaving. Furthermore, the purpose of artificial light control in the breeding room without windows is to stabilize the biological clock of the experimental animals.

A. Vision is degraded and other senses are extremely sensitive.

Since rodents are nocturnal, the sensitivity of their five senses, including vision, has been extremely degraded, while vibrissae, hearing, and smell are extremely sensitive. Therefore, the caged mice in the animal center can maintain normal life if they are blind. However, they are easily frightened by sudden noises, unfamiliar smells, etc. Of the five animals mentioned in this section, guinea pigs are the most vulnerable to fright.

B. Pheromones are the “language” of chemistry

In rodents and lagomorphs, the reception of pheromones through specialized olfactory organs is an important mediator that affects individual behavior and physiological status. The following four effects discovered in mice from the late 1950’s to the early 1960’s have all been confirmed to be physiological changes caused by pheromones.

a. Lee-Boot effect:

When sexually mature female rats are intensively raised in small breeding cages and there are no sexually mature male rats in the breeding room, the estrous cycle of female rats will be extended from 4-5 days to 10-14 days (Table 1) . This is because the luteal phase in the estrous cycle is extended by 8-10 days, and it has been confirmed that this physiological change is similar to pseudopregnancy.

b. Whitten effect:

When the physiological state of female rats has shown the Lee-Boot effect, if a sexually mature male rat appears in the breeding cage, most female rats will come into estrus 3-4 days after the male rat appears. In the breeding of experimental animals, this effect is often used for production management of estrus synchronization.

c. Vandenbergh effect:

When sexually immature female rats are intensively raised in a breeding cage and there are no sexually mature male rats in the breeding room, the age of puberty of the female rats must be 7-8 weeks. However, if a sexually mature male rat appears in the breeding cage, the female rat will become pregnant at the age of 5 weeks.

d. Bruce effect:

When a female rat has just received mating and a sexually mature male rat "unknown" to the female rat appears in the breeding cage, the embryo developed from the fertilized egg (zygote) will not implant in the uterus and terminate the pregnancy (Table 1).

Table 1. Basic growth and reproductive traits of experimental mice, experimental rats and Syrian hamsters.

| Species | Guinea pig | | Rabbit | | Syrian hamster | |
|---|---|---|---|---|---|---|
| Sex | ♂ | ♀ | ♂ | ♀ | ♂ | ♀ |
| Development from birth to weaning | | | | | | |
| Birth weight (gm) | 1.0-2.0 | | 4-6 | | 1.5-3 | |
| Lower/upper incisors growing age (days) | 9/13 | | 9/13 | | Already grown at birth | |
| Ear hearing age (days) | 3-4 | | 3-4 | | 4 | |
| Age of hair growth (days) | 6-7 | | 6-8 | | 9 | |
| Visual age of eyes (days) | 12-14 | | 12-15 | | 12-14 | |
| Number of nipple pairs | 5 | | 6 | | 7-11 | |
| Visible nipple age (days) | | 7-10 | | 9-10 | | - |
| Weaning age (weeks) | 3-4 | | 3-4 | | 3-4 | |
| Weaning weight (gm) | 8-15 | | 30-50 | | - | |
| First time in estrus (days) | 35-50 | 27-60*[1] | 48-64 | 48-64 | 63-91 | 28-56*[1] |
| Testicles descend into scrotum | 14 | | 21-49 | | - | |
| Weekly age of vaginal opening (weeks) | | 28-35 | | 49-65 | | - |
| Age of first keratinization of vaginal epithelium (days) | | 27-60 | | - | | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| Adult weight (gm) | 25-40 | 20-40 | 300-520 | 250-300 | 85-140 | 95-160 |
| The distance from genital pore to anus in adult mice | 10-15mm | 5-6mm | - | - | - | - |
| Estrous cycle (days) | | 4 (3-9) | | 4-5 | | 4 |
| Follicular phase (days) | | 2 | | 2 | | 2 |
| Luteal phase (days) | | 2 | | 2-3 | | 2 |
| Estrus phase (hrs) | | 12-14 | | 10-20 | | 4-23 |
| Pregnancy (days) | | 18-21 | | 21-23 | | 15.5-16 |
| Mating to fertilization (hrs) | | 2 | | 2 | | - |
| Mate to blastocyst stage (days) | | 2-4 | | 3-5 | | - |
| Mating to implantation (days) | | 4-5 | | 5-7 | | 5-6 |
| False pregnancy (days) | | 10-13*[2] | | 10-14*[2] | | 7-13*[2] |
| Number of pups per litter | | 3-15 | | 3-18 | | 5-9 |
| Postpartum estrus | | (+) | | (+) | | (+)*[3] |
| Interval between births (weeks) | | 3-6 | | 3.5-7 | | 5-6 |
| Routine breeding | | | | | | |
| Breeding age (weeks) | 6-10 | 6-10 | 8-14 | 8-14 | 10-14 | 6-10 |
| Breeding system | monogamy or polygyny | | monogamy or polygyny*[4] | | monogamy | |
| Reproductive index (number | | 0.5-2.5 | | | | 0.7-1.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| of pups weaned/breeding mother/week) | | | 0.5-2.0 | | | |
| Elimination after the litter number of births | | 2-10 | | 4-10 | | 4-7 |
| Number of months from breeding to elimination | 4-12 | 4-10 | 6-24 | 6-18 | 6-12 | 6-12 |
| Digestive tract emptying time (hrs) | 8-14 | | 4-5 | | - | |
| Number of chromosomes | 40 | | 44 | | 44 | |

*1 See Vandenbergh effect.

*2 In addition to infertility caused by mating, Lee-Boot effect can also be caused.

*3 Hamsters have postpartum estrus (postpartum estrus) but do not become pregnant.

*4. Rats can also mate polyandrously at the same time.

From the above, it can be seen that the ovarian physiology of female rodents is not only easily affected by the environment. Even under constant environmental conditions, the cyclical changes in ovarian endocrine still affect the overall physiology. Therefore, unless there are special purposes, male animals are generally used when conducting research on non-reproductive phenomena or statutory safety tests. This has resulted in an imbalance in the demand for experimental animal breeding and supply units, with approximately 3 male animals needed for every supply and only 1 female animal required. However, the SHR and WKY rats used routinely in the Cardiovascular Research Institute of our university rarely require female rats.

3. Unavoidable variables

When conducting animal experiments, although the environmental conditions and the genetics of experimental animals are standardized, there are still many variables that cannot be controlled. For example: even if the genes of closely related strains are 99% identical, the litter size of female animals is not necessarily the same during breeding. When the litter size is different, the birth weight and growth rate of the litter will also be different. Therefore, even under strict manual control, there are still many unavoidable problems and variable (intangible variance) exists.

4. Gender identification

Like general mammals, the anogenital distance between the anus and the genital pore of male animals is determined by sex differentiation during the embryonic stage; androgen (androgen) acts here, making the distance between the two pores longer than that of female animals. So it can be the main method to distinguish the gender of animals.

In guinea pigs and rabbits, there is no obvious difference in the distance between the anus and the genital pore between the sexes. Therefore, it takes more experience to distinguish the gender. You can gently press the protrusion of the genital pore. If the penis can be squeezed out from the genital pore (foreskin), it can be known that it is male (Figure 3 and Figure 4).

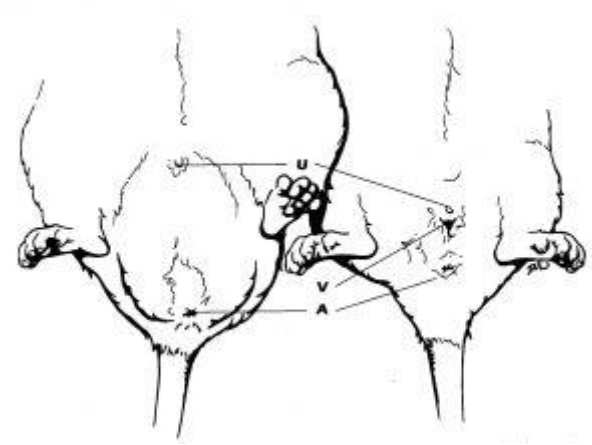


Figure 1. mouse and rat

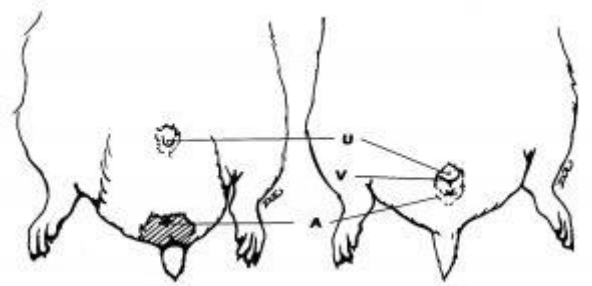


Figure 2. Syrian hamster

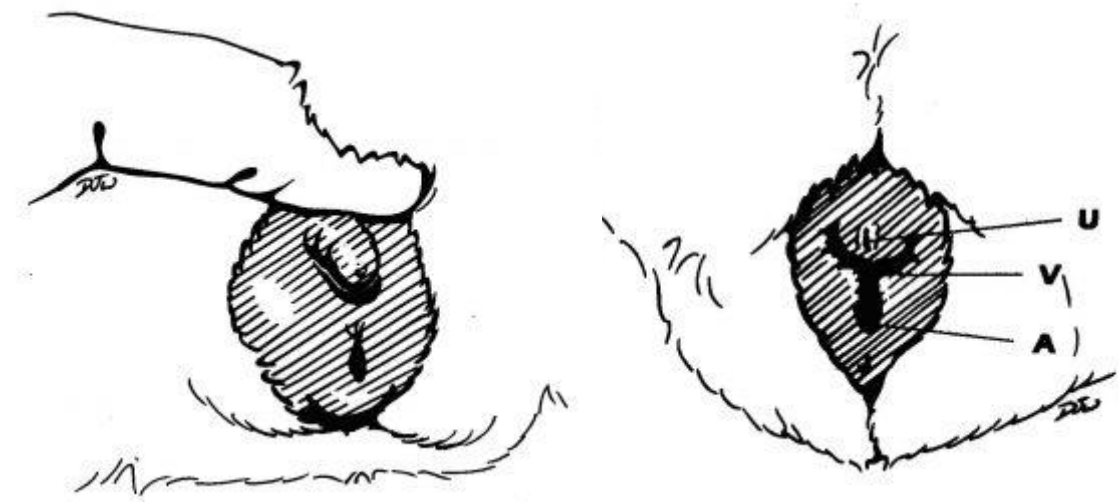


Figure 3. Guinea pig

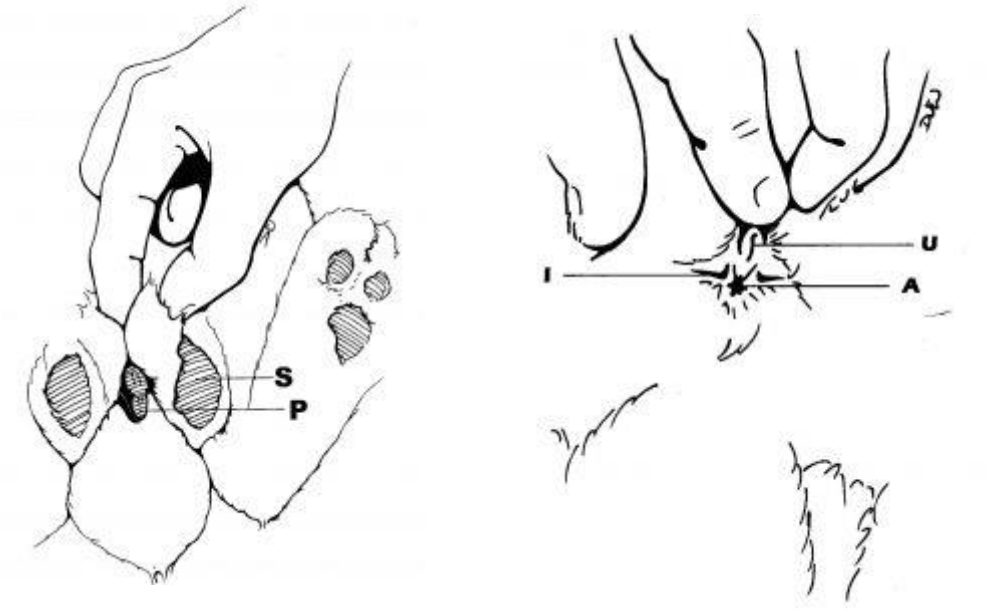


Figure 4. Rabbit

Mice, rats (Figure 1) and hamsters (Figure 2) can be distinguished by the distance from the anus to the genital opening (urethral opening and vaginal opening). Male mice are obviously longer, so the difference between (Figure 1) and (Figure 2). The animals on the left are all male, and the ones on the right are females. The anus and genital pores (Figure 1) of mice and rats are very similar in relative position and shape, with only the species differing in size. Guinea pigs (Figure 3) and rabbits (Figure 4) are known to be male because the animals on the left side can squeeze the penis out of the foreskin (genital pore). In addition, the genital pore and anus of female guinea pigs form a "Y" shaped notch (right side of (Figure 3)), which can also be used to identify the gender. The inguinal cannel of rodents is open. When a male rodent is nervous or cold, the testicles will retract from the scrotum into the abdominal cavity. In sexually mature male rabbits (left side of (Figure 4)), the testicles do not retract into the abdominal cavity, so an obvious scrotum is visible. U = urethral opening, V = vaginal opening, A = anus, S = scrotum, P = penis, I = inguinal scent gland is a specialized sebaceous gland of rabbit (right side of (Figure 4)).

5. Male animals and scheduled mating

A. Rodents

Male rodents have very developed sex accessory glands. During intercourse and ejaculation, the semen secreted by the accessory glands will solidify at the reproductive tract of female animals, forming a vaginal plug, which will adhere there

2-12 Hour. During time-mating, vaginal plugs can be used as a basis for whether the female rat has accepted mating.

B. Rabbit

The accessory gonads of domestic rabbits are not well developed and there is no vaginal plug, but the mating process (courtship) is shorter than 1 minute. Therefore, only the female rabbit in estrus is placed in a male rabbit breeding cage for scheduled mating of rabbits. When a rabbit ejaculates, you can know by its obvious posture.

6. The red eyes of the "white" mouse

Most people call experimental animals "white mice", "white rats", "white rabbits", etc., which are inappropriate names. In fact, there are many stocks and strains of animals that are not "albino". If it is truly a "white" animal, its eyes will be colorless and transparent due to the lack of pigment, so the red eyes will be blood-colored. When a white animal has severe anemia or poor blood circulation, its eyes will appear dark red, but will appear transparent after death.